System Realization for Video Surveillance with Interframe Probability Distribution Analysis

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ABSTRACT

A system realization for video surveillance with interframe probability distribution analysis is presented in this paper. The system design is based on a high performance DSP processor, video surveillance is implemented by analyzing interframe probability distribution for scanning objects in a restricted area and the video analysis algorithm is decided for forming a different image from the probability distribution of several frames compressed by the standardized JPEG. The algorithm processing time of D1(720x480) image per frame is 85ms.

KEYWORD
Interframe probability distribution, video surveillance, DSP, video system and JPEG

I. INTRODUCTION

A video surveillance systems stand in an important application field that has been researching for diverse application by generating image data from a position and pattern analysis of a moving or still objects to diversify multimedia services. In case of the conventional video surveillance system, a weakness of the security is exposed by depending on the manual operation because operator makes an observation and a decision about transmitting image. In addition, the system is realized with recording into storage media for transmitted whole images results in a defect taking a lot of time to search for a specific image.[1-8] In contrast, interframe probability distribution analysis for video analysis algorithm and system lead to the good security and fast searching relatively. The reasons are that a operator is observed by transmitting the specific image detected object at the restricted area only, and reduced to searching time on the database of specific images. Thus video surveillance system based on hardware with interframe probability distribution analysis algorithm is realized.

II. SYSTEM REALIZATION AND ALGORITHM

2-1. System configuration

Video system is composed of video encoder and image processing from input image to output network. This blocks are implemented by executing the algorithm by receiving video signal from camera and transmitting the compressed image stream. As shown in Fig.1 system configuration, video encoder makes quantization for digital image stream. A high performance DSP processor based on hardware is composed of preprocessing, video analyzing and JPEG compressed data processing components. DSP processor is included video block inside. The interface doesn't need video encoder and extra logic, and has 8 ALU to execute 8 instructions per cycle. A lot of computational routines are coded by assembly language to tune up DSP core architecture because compiler is not good to optimize. As illustrated in Fig. 2 video Analysis consists of foreground and background subtraction, and object detection and analysis. Preprocessing is arranged only Y component in Y Cb Cr color system. Video analysis is divided into background image and region of object,

detected the moving image and decided the changed image using interframe probability distribution.

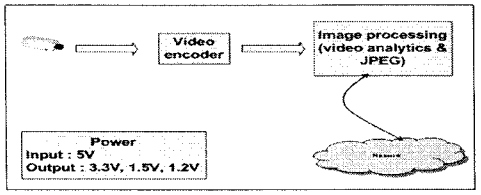


Fig. 1. System configuration

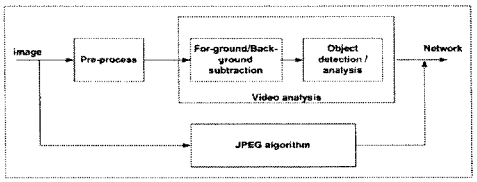


Fig. 2. Video analytics and JPEG

2-2. Interframe probability distribution

The probability distribution analysis is composed of 5 models for dividing into foreground image and moving object. This model is given by the following equation (1).

$$x \sim \sum_{i=1}^{5} \pi_i N_3(\mu_i, \Sigma_i) \quad (1)$$

where weighted value π_i

$$\pi_i \geq 0, i = 1,.....,5 \text{ and } \sum_{i=1}^{5} \pi_i = 1),$$

$N_3(\mu_i, \Sigma_i)$ is trivariate normal distribution given by vector mean μ, and variance and autovariance matrix Σ. This equation is described by the following equation (2).

$$x \sim \sum_{i=1}^{5} \pi_i N_3(\mu_i, \sigma_i^2) \quad (2)$$

where σ_i^2 is variance.

Trivariate normal distribution of probability distribution model is decided by variations of weighted value π_i, vector mean μ_i and variance σ_i^2. Probability distribution on the pixels are depicted in Fig. 3.

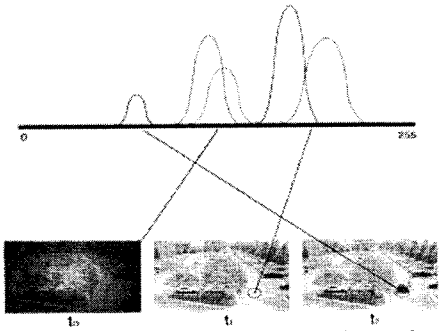


Fig. 3. Probability distribution on the pixels

As shown in Fig. 3, five probability distribution model shows in which model belongs to probability distribution value to arbitrary pixels at t0, t1, t2. As shown in Fig. 4, 1-3 models are background image and 4-5 are moving object are classified due to base on five probability distribution model is given by the relation between weighted value π(or w) and variance σ. The new inputting image from incoming point is discriminated whether the background image or moving image by which probability distribution value belongs to model. Probability distribution model enables to select the five model in initial processing of algorithm. Fig 4 shows the discriminating way for foreground moving object and background image. The discriminated image is computed the position of coordinate and size. This value enables to classify a sort of objects; person, vehicle and so on using recognizing algorithm.

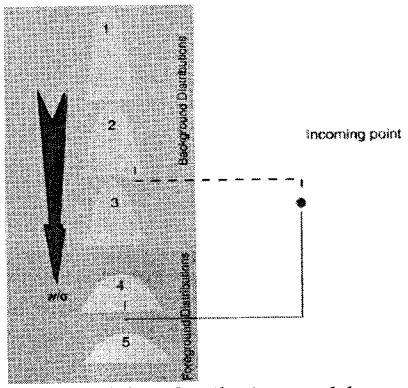
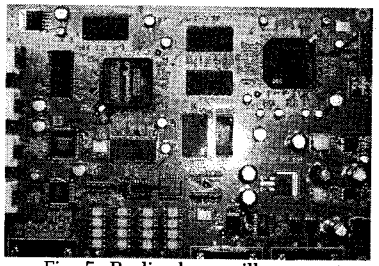


Fig. 4. Probability distribution model

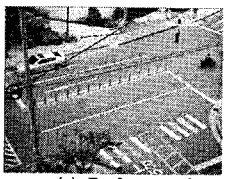
III. EXPERIMENTS

The realized video system board is shown in Fig 5 based on DSP processor, and the experimental images are used D1(720x480) from CCD camera.

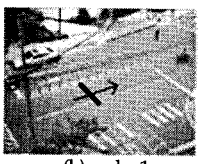


Fig, 5. Realized surveillance system

The experimental process is displayed in Fig. 6. The background image not moving is depicted in Fig. 6 (a) and each rules are defined in a restricted area as shown in Fig.6 (b), (c), (d) and (e) marked bold dash line respectively. The moving image doesn't need to scan the full image and also classify a person, vehicle and so on. The full detecting is just operated by violating the rules, and transmit to host server computer. For instance, a parking lot makes a rule to check entrance line and sensor. The system doesn't transmit scanning image to the host unless the rule doesn't work.

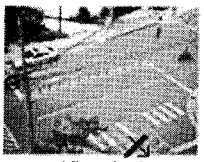


(a) Background

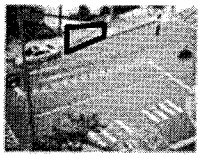


(b) rule 1

(c) rule 2



(d) rule 3

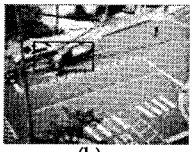


(e) rule 4

Fig, 6. Background Image and rule images

The result surveillance images are shown in Fig. 7 with 4 rules in Fig. 6. The car and motorcycle are detected by rule 1 as in Fig. 7 (a) and (b) marked bold dash line via Fig. 6 (b). In case of Fig. 6 (c) rule 2, person, vehicle and motorcycle are detected as shown in Fig. 7 (c) to (f). The rule 3 forces to detect a car as displayed in Fig. 7 (g) to (h). And also rule 4 detect the moving person as shown at the bottom of Fig. 7 (i).

(a)



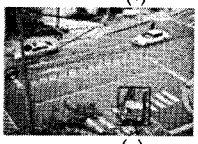
(b)

(c)

(d)

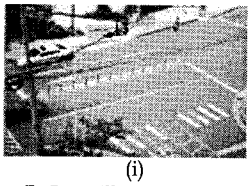
(e)

(f)



(g)

(h)



(i)

Fig. 7. Surveillance result images

Table 1. System processing time

Components	Processing times[ms]
Preprocessing	1.5
Interframe probability distribution video analysis	73.1
JPEG Compression	10.0
Transmitting time	0.4
FPS	**85.0**

The experimental result of algorithm processing time is shown in Table 1. The moving image detection time takes about 85ms, and the system is processed at 12 FPS(Frame Per Second). This keeps around 100% detection for non-fast moving image.

IV. CONCLUSIONS

A system realization for video surveillance with interframe probability distribution analysis based on a high performance DSP processor is presented in this paper. The system processing time is around 85ms, and enable to process at 12 FPS. Probability distribution computation takes a most processing time. The surveillance result keeps 100% with the limited rules in a restricted area. In future video analysis algorithm needs to optimize and develop for faster, and research for a intelligent surveillance system and algorithm.

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